

Corrosion and Protection of Steel (Cont.)

SOV/3133

Andreyeva, V.G. [Engineer], P.V. Strekalov [Engineer], and M.A. Vedeneyeva.
Corrosion Resistance of 1Kh18N9T-steel Welded Joints

228

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TOMASHOV, N.D.

PAGE I BOOK EXPLORATION

RCV/5559

Academy наук ССРН. Institut metallurgii. Nauchnyj sovet po problemam zharkoprochnych splavov
Issledovaniye po zharkoprochnym splavam, t. 5 (Investigations of Heat-Resistant Alloys, Vol. 5). Moscow, Izd-vo Akad. Nauk, 1979. 423 p. Kratkaia sluzhba insertant. 2,000 copies printed.

Na. of Publishing House: V.A. Klimov; Tech. Ed.: I.P. Kartash; Editorial Board: Academician G.V. Kurdyumov, Academician N.V. Arutyunyan, Corresponding Member, USSR Academy of Sciences (Rep. Ed.), I.A. Ogin, I.M. Pavlov, and I.M. Zaitsev, Candidates of Technical Sciences.

Purpose: This book is intended for metallurgical engineers, research workers in metallurgy, and may also be of interest to students of advanced courses in metallurgy.

contents: This book, consisting of a number of papers, deals with the properties of heat-resistant metals and alloys. Each of the papers is devoted to the study of the factors which affect the properties and behavior of metals. The effects of various elements such as Cr, Mo, and V on the heat-resisting properties of various alloys are studied. Deformability and workability of certain metals are related to the thermal conditions due the object of metal study described. The problems of hydrogen embrittlement, diffusion and the deposition of metals onto metal surfaces by means of electrolytes are examined. One paper describes the apparatus and methods used for growing monocrystals of various metals new criteria examined. Results are given of studies of intermetallic bonds and the behavior of atoms in metals. Tests of surfaces and compressor blades are described. No personalities are mentioned. References account for most of the articles.

Fedorov, B.M., V.N. Malyutin, and M.M. Kolenko. Production of forgings for turbine and compressor blades 277

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PHASE I BOOK EXPLOITATION SOV/3587

Tomashov, Nikon Danilovich

Teoriya korrozii i zashchity metallov (Theory of Corrosion and Protection of Metals) Moscow, Izd-vo AN SSSR, 1959. 591 p. Errata slip inserted. 4,000 copies printed.

Sponsoring Agency: Akademiya nauk SSSR. Institut fizicheskoy khimii.

Eds. of Publishing House: N.G. Yegorov and A.V. Shreyder; Tech. Ed.: I.F. Kuz'min.

PURPOSE: This book is intended for scientific research workers, metallurgists and engineers studying the corrosion of metals and methods of prevention.

COVERAGE: The book is an analytic study of the corrosion of metals. Scientific principles governing the process of corrosion of metals and means of prevention are investigated. The author explains the theory of corrosion and outlines its stages of development, gives an analysis of solid bodies, and describes the crystalline

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Theory of Corrosion (Cont.)

SOV/3587

structure of metals and the main features of electrolytes. Part I treats chemical corrosion: the mechanism of oxidation, growth of films and the laws governing this phenomenon, and protection of metallic structures by alloying and coating. Part II analyzes problems of electrochemical corrosion: electrode potentials, the operation of corrosive galvanic cells, corrosive currents, polarization and depolarization phenomena, and factors inhibiting and accelerating electrochemical corrosion. Part III outlines the mechanism of corrosion and analyzes factors of atmospheric, soil and marine corrosion. Part IV investigates the corrosion resistance of various metals and alloys, analyzes the composition of different metals, and lists the metals most resistant to corrosion. The conclusion contains a number of suggestions for further study in corrosion prevention. The author thanks M.N. Tyukina, Ye.N. Paleolog, G.P. Chernova, Yu.N. Mikhaylovskiy, A.F. Lunev, M.A. Timonova, V.N. Modestova, T.V. Matveyeva, A.V. Byalobzheskiy, N.P. Zhuk, A.V. Shreyder, V.A. Titov, M.A. Vedeneyeva, A.A. Lokotilov, G.K. Berukshtis, O.G. Deryagina, A.Z. Fedotova, M.N. Fokin, Ye.N. Mirolyubov, N.I. Isayev, R.M. Al'tovskiy, P.V. Shchiglev, L.S. Kupriyanova, O.N. Markova,

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Theory of Corrosion (Cont.)

SOV/3587

S.A. Baykova, L.A. Leonidova, and Professors S.G. Vedenkin and A.V. Ryabchenkov. Each chapter is accompanied by references.

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To MASHOV, N.D.

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PHASE I BOOK EXPLOITATION

18(7)16(7)

Zashchita podzemnykh stali i metallicheskikh struktur ot korrozii (Protection of Underground Metal Structures from Corrosion). Manual. Protection of Underground Metal Structures from Corrosion. Manual. Moscow, 1st-ye izd., 1956. 1600 khr. RIFSB, 1958. 743 p. Errata slip inserted. 6,000 copies printed.

M.I. Bryukhov, Ed. of Publishing House: V.O. Akademiya Tech. Nauk, Ye. S. Petrovskaya.

PURPOSE: This collection of articles is intended as a manual on corrosion protection of underground metal structures.

CONTENTS: The book is divided into four parts. The first part gives information on the characteristics of underground metal structures and sources of stray currents. The second part deals with the theory of soil corrosion of metals and the theory of stray currents. The third part deals with the problem of combating leakage from sources of stray current, methods and devices for investigating corrosion and the fundamental principles of planning corrosion prevention. The fourth part explains measures for preventing corrosion of underground metal structures and gives the basic operating principles of equipment involved. No personalities are mentioned. References follow.

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TOMASHOV N. D.

30V/2216

PURPOSE: This book, "Electrochemistry," presents at a general level the 136 reports presented at the Fourth Conference on Electrochemistry sponsored by the Department of Chemical Sciences and the Institute of Physical Chemistry of the Academy of Sciences, USSR. The collection pertains to different branches of electrochemical kinetics, double layer theories and galvanic processes in metals, electrodeposition and each divisional branch of electrochemistry. Abridged discussions are given at the end of each chapter. No reports have been omitted.

Burshansk, N. N. (Institute of Electrophysiology, Academy of Sciences, USSR). Investigating the Passivation of Metals by Means of Measuring the Contact Potential. 603

Mirolyubov, Ye. M., N. D. Tsvetkov, and M. P. Zhukov. Institute of Physical Chemistry, Academy of Sciences, USSR]. *Paus-*
Difference and Similarity in the Oxidizing Methods
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605

1957 of Iron in USSR
1955) filled an SSE-Kazan branch,
Bodily by U.S. (Kazan) Some Regularities of Local
Academy of Sciences (USSR) Under Conditions of Local
Anodic Dissolution of Metals

Passivation (Gaudersatvenny initicut prikladnoy khimii). **Passivity of Iron in Acid Solutions** (Gaudersatvenny initicut prikladnoy khimii). **State Institute of Applied Chemistry.** 621

ROROBKOV, I. V. Anodic Passivation of
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M. N. Mikhaylovskii [Institute of Physical
Tobolsky, M. D., and Yu. N. Mikhaylovskii] Electrochemical
Chemistry, Academy of Sciences USSR. Electrodes of
Kinetics of Corrosion Processes Under Absorbed Films of
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S/081/60/000/020/008/01⁴
A006/A001Translation from: Referativnyy zhurnal, Khimiya, 1960, No. 20, p. 295, # 81⁴39

AUTHORS: Tomashev, N.D., Berukshtis, G.K.

TITLE: A Method of Determining the Rate of Corrosion Processes Under Thin Electrolyte Films

PERIODICAL: Tr. In-ta fiz. khimii, AN SSSR, 1959, No. 7, pp. 5-10

TEXT: The authors describe a new electrochemical method of determining the corrosion rate from the magnitude of current on the model of a micro-corrosion element, assembled from thin dissimilar metal plates having different electrochemical potentials and serving as cathodes and anodes. The anode and cathode plates, alternating in the packet, are insulated from each other by a varnish or mica layer. The operating surface of the model is formed by the well-polished faces of the metal plates and the insulation. The conventional thickness of the metal plates is ~ 0.5 mm, and that of the insulation is $30 - 50 \mu$. Contact panels are arranged on the lower section of the packet, connected with the model anodes by conductors; all the cathodes are parallel switched to one common conductor.

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S/081/60/000/020/008/01⁴
A006/A001

A Method of Determining the Rate of Corrosion Processes Under Thin Electrolyte Films ✓

This method of switching makes possible to switch off any number of electrodes in case of necessity and to change the correlation of the cathode and anode surfaces of the model. It is shown that this method makes possible the study of basic regularities: the effect of temperature, concentration and composition of the electrolyte, and the intensity of mixing the medium, on the corrosion rate in adsorption and visible moisture films and in the electrolyte volume; the method can be used to investigate the corrosion rate under various conditions.

A. Moskvicheva

Translator's note: This is the full translation of the original Russian abstract.

Card 2/2

S/081/60/0CC/020/004/014
A006/A001

Translation from: Referativnyy zhurnal, Khimiya, 1960, No. 20, p. 294, # 81433

AUTHCRS: Tomashov, N.D., Modestova, V.N., Blinchevskiy, G.K.

TITLE: Methods of Investigating Corrosion and Electrochemical Behavior of Metals Under Stress

PERIODICAL: Tr. In-ta fiz. khimii, AN SSSR, 1959, No. 7, pp. 64-77

TEXT: The design of a machine was developed for corrosion tests under stress with a time-constant load, permitting the operation at higher temperatures and measuring simultaneously the potential of the specimen. The corrosion behavior under stress of MA9 alloy was tested (low-alloy magnesium base alloy) in 0.001 n. NaCl solution and in a solution containing 35 g/l NaCl + 20 g/l K₂CrO₄. It is shown that in 0.001 n. NaCl solution, when stress is absent, the corrosion defects appear in the form of multiple rounded micropittings. In the presence of stress, the micropittings transform into slits or intercrystallite cracks. In a 35 g/l

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S/081/60/000/020/004/014
A006/A001

Methods of Investigating Corrosion and Electrochemical Behavior of Metals Under Stress

NaCl + 20 g/l K₂CrO₄ solution, coarse spotty corrosion is observed. The stress does practically not affect the shape of pittings.

From the authors' summary

Translator's note: This is the full translation of the original Russian abstract.

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S/137/60/009/008/009/009
A006/A001

Translation from: Referativnyy zhurnal, Metallurgiya, 1960, No. 8, p. 316,
18903

AUTHORS: Tomashev, N. D., Isayev, N. I.

TITLE: Using the Ohmic-Capacity Method to Investigate the Behavior of
Protective Films During Corrosion of Metals in Strained State

PERIODICAL: Tr. In-ta fiz. khimiy, AN SSSR, 1959, No. 7, pp. 78-84

TEXT: The authors describe a method consisting in the combined measurement
of a double electric layer on metal surfaces (metal-electrolyte) and of the ohmic
resistance, to study the state of a protective oxide film during corrosion under
tensile stress conditions. There are 7 references. 16

Yu. L.

Translator's note: This is the full translation of the original Russian abstract.

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S/081/60/000/017/007/016
A006/A001

26.16.20
Translation from Referativnyy zhurnal, Khimiya, 1960, No. 17, pp. 74-75,
68756

AUTHORS: Fckin, M.N., Matveyeva, T.V., Tomashov, N.D.

TITLE: Cells for Testing Metal-Solution Systems Under the Effect of Elec-
tronic Radiation With Consideration of Polarization Phenomena

PERIODICAL: Tr. In-ta fiz. khimii AN SSSR, 1959, No. 7, pp. 114-118

TEXT: Designs of a cell are suggested where the metallic electrode is polarized anodically (cell a) and cathodically (cell b) during electronic irradiation of the metal-solution system. Characteristics of radiation are: electron energy ~ 1 Mev; density of the electron flux: 3.3×10^{13} electron/cm². sec; power of a dose in a layer of the solution near the electrode of 1-mm thickness: 6.6×10^{19} ev/cm³ sec. Thickness of the layer of the circulating solution (3% NaCl) over the electrode in cell "a": 1 and 10 mm (less and more than the thickness of the layer of full absorption of the electron radiation energy). In cell "a" at a thickness of the solution layer equal to 1 mm, the corrosion rate of

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A006/A001

Cells for Testing Metal-Solution Systems Under the Effect of Electronic Radiation
With Consideration of Polarization Phenomena

1X18H9T (1Kh18N9T) steel is by 2 orders of magnitude higher than that of a non-irradiated specimen. The nature of destruction and the corrosion rate in irradiation are different from those with anodic polarization of the specimen from an external current source. These differences were not observed if the thickness of the layer was 10 mm. The placing of a protector or cathodic polarization of the specimen in cell "a" protects it against increased corrosion during irradiation.

D. Kokoulina

Translator's note: This is the full translation of the original Russian abstract.

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S/081/60/000/017/008/016
A006/A001

18

Translation from: Referativnyy zhurnal, Khimiya, 1960, No. 17, p. 75, # 68757

AUTHORS: Tyukina, M.N., Zalivalov, F.P., Tomashev, N.D.

TITLE: Electron-Microscopical Study of the Microstructure of Anodic Oxide
Films on Aluminum ✓

PERIODICAL: Tr. In-ta fiz. khimii, AN SSSR, 1959, No. 7, pp. 165-174

TEXT: The authors studied the effect of electrochemical conditions of obtaining anodic oxide films on Al upon their structure and physico-chemical properties. The Al surface was investigated after removal of the oxide film in hot solution of 35 ml/l H_3PO_4 , and 20 g/l CrO_3 . The surface of the oxide film and the transverse and longitudinal splits of the oxide film were also studied. A method is described of obtaining carbon imprints from anodic oxide film splits. It is shown that anodic oxide films on Al surfaces consist of close-packed cells in the form of hexagonal prisms, arranged with their base faces parallel to the anode surface. The cellular structure is formed within 3-7 sec after application of the anode current and does not change with a further growth of the oxide film

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Electron-Microscopical Study of the Microstructure of Anodic Oxide Films on
Aluminum

thickness. The pore size in the oxide film increase linearly with an increase of the forming tension. It is shown that the particular properties of anodic oxide films (hardness, resistance against corrosion and wear) obtained by the method of hard anodizing, are explained by the increased size of oxide cells, forming the oxide film, due to the thickening of their walls.

✓
Yu. Polukarov

Translator's note: This is the full translation of the original Russian abstract.

Card 2/2

9 (6)
AUTHORS:

Zalivalov, F. P., Tyukina, M. N.,
Tomashov, N. D.

SOV/32-25-6-17/53

TITLE:

Investigation of the Microstructure of Anodic Oxide Films on
Aluminum by the Aid of the Electron Microscope
(Issledovaniye mikrostruktury anodnykh okisnykh plenok na
alyuminii pri pomoshchi elektronnogo mikroskopa)

PERIODICAL:

Zavodskaya Laboratoriya, 1959, Vol 25, Nr 6, pp 696-698 (USSR)

ABSTRACT:

A method was devised, permitting the determination of the cell structure of anodic oxide films on aluminum (Fig 1). By this method no impression is taken of the film on the metallic anode surface (Ref 1); instead, replicas are prepared of such films. The method is based on the operation of taking off and subsequently comminuting the oxide film, thus obtaining microscopic particles which are split along the side- (longitudinal section) or bottom- (cross section) plane of the hexagon lattice structure. Reproductions of these planes of shear may be obtained by the carbon-replica method (Ref 2). The preparation procedure is described. Observations were made with the electron microscope EM-3 or UEM-100, and the samples under investigation were of AV000 aluminum (99.99 % Al), which

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Investigation of the Microstructure of Anodic Oxide SOV/32-25-6-17/53
Films on Aluminum by the Aid of the Electron Microscope

were oxidized anodically in a 4 % sulphuric acid solution by the method of the hard anodization (Refs 3, 4) (Figs 2, 3). The figures show that the oxide film is a dense packing of cells in the form of hexagon prisms. Data are supplied of the dimension and quantity of cells (Table); they agree with data obtained with an earlier described method (Ref 1). There are 3 figures, 1 table, and 4 references, 2 of which are Soviet.

ASSOCIATION: Institut fizicheskoy khimii Akademii nauk SSSR (Institute of Physical Chemistry of the Academy of Sciences, USSR)

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SOV/32-25-6-19/53

28(5)
AUTHORS:

Tomashov, N. D., Isayev, N. I.

TITLE:

Method of Investigating Corrosive and Electrochemical Properties
of Metals in the State of Stress (Metod issledovaniya korro-
zionnykh i elektrokhimicheskikh svoystv metallov v napryazhennom
sostoyanii)

PERIODICAL: Zavodskaya Laboratoriya, 1959, Vol 25, Nr 6, pp 700 - 702 (USSR)

ABSTRACT:

Phase oxide films on metal surfaces exhibit a greater electric resistance so that a change in electric resistance and capacity is observable when submitting a sample to a stress causing the destruction of the oxide film. The degree of film destruction may be evaluated by the rate and magnitude of such variations. A system was devised based on this principle and used for the investigation of the surface oxide layer state according to the electric resistance-capacity method in sample stressing treatments. It may be observed from the scheme of the system (Fig 1) and from the description that an electric current supplied by an AC generator ZG-10 and having a potential of 10-15 mv is used here. The circuit compensation is done by selecting appropriate capacities with the AC current resistor KMS-6. The

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Method of Investigating Corrosive and Electrochemical Properties of Metals in the State of Stress SOV/32-25-6-19/53

compensation moment is determined according to the minimum of the AC current amplitude on the oscillograph. The test takes place in a special vessel (Fig 2) in which the wire-shaped sample is stretched (diameter 1-2 mm). The experimental results obtained (Fig 3 on anodized aluminum, Fig 4 electropolished Al, Fig 5 stainless 3Kh13 steel) show that in the case of deformations damaging the oxide film the capacity of the latter is increased, electric resistance drops and the electrode potential shifts to more negative values. This holds for the case that the new-formed oxide films (on the damaged spots) exhibit a weaker electric resistance than the primary films. To be sure, also new oxide films may form whose conductivity is lower than the one of primary films as, for example, is the case with 3Kh13 steel in 12 n HNO₃ (Fig 6). There are 6 figures.

ASSOCIATION: Institut fizicheskoy khimii Akademii nauk SSSR (Institute of Physical Chemistry of the Academy of Sciences of the USSR)

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28 (5)

AUTHORS:

Tomashev, N. D., Byalobzheskiy, A. V., Sov/32-25-6-31/53
Val'kov, V. D., Zalivalov, F. P.

TITLE:

Device for the Rapid Determination of the Quality of Anodic Oxide Films on Aluminum and Its Alloys (Pribor dlya bystrogo opredeleniya kachestva anodnykh okisnykh plenok na alyuminii i yego splavakh)

PERIODICAL:

Zavodskaya Laboratoriya, 1959, Vol 25, Nr 6, pp 738-739 (USSR)

ABSTRACT:

For the detection of defective parts of anodic films the device K-1 by G. V. Akimov and Ye. N. Paleolog is usually used. The device permits the detection of very small defects, does, however, not indicate the general quality of the film; another disadvantage is the use of a sodium chloride solution which may lead to a corrosion of the film. Therefore, a new device was designed, K-2 - very similar to K-1; the mode of operation of the new device is based upon the fact that the conductivity of the anodic oxide film is the greater the more porous it is. The construction of the detector of defects (Fig 1) is somewhat modified, stainless steel 1 Kh18N9 or zink serve e. g. as electrode as copper and aluminum may together form an electric cell. The device

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Device for the Rapid Determination of the Quality of SOV/32-25-6-31/53
Anodic Oxide Films on Aluminum and Its Alloys

(Fig 2, Scheme) has piles as direct-current transmitters
(2-4 v) so that a non corroding electrolyte may be used
(0.1 % solution of potassium- or sodium bichromate). There
are 2 figures.

ASSOCIATION: Institut fizicheskoy khimii Akademii nauk SSSR (Institute
of Physical Chemistry of the Academy of Sciences, USSR)

Card 2/2

18 (7)
AUTHORS:

Tomashov, N. D., Andreyev, L. A.,
Isayev, N. I.

05727

SOV/32-25-10-16/63

TITLE:

Comprehensive Investigation of Stress-Corrosion Cracking Processes

PERIODICAL:

Zavodskaya laboratoriya, 1959, Vol 25, Nr 10, pp 1200 - 1203
(USSR)

ABSTRACT:

A device and a suitable method for simultaneous microscopic and electrochemical investigation of stress-corrosion cracking processes were developed. The device includes a tensile-testing machine with a visual and measuring recording system. Axial tensile loads up to 250 kg can be applied; the total electrode potential of the metal, and the potentials in the resulting cracks, are automatically recorded, and visual observation of the propagation kinetics of cracks is possible. The tests are carried out in a corroding medium which is constantly renewed. The loading (stretching) takes place on the tensile-testing machine (Fig 1) by means of a metal spring, and is adjusted by a set wheel. Visual observation of the sample (of cracks) is done by a microscope of type MIS-11. The tensile-testing machine was adjusted by a dynamometer of type DS-1. Immediately before the test loading, the corroding liquid was put on the

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Comprehensive Investigation of Stress-Corrosion Cracking
Processes

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sample by a glass tube. The changes in the electrochemical potential in the cracks were measured by means of appropriate capillaries, an electron amplifier (Fig 2, Diagram), and a loop oscillograph of type MPO-2. The corrosion of alloy MA 2 was tested in a solution of Na_2CrO_4 (20 g/l) and NaCl (35 g/l). The oscillogram (Fig 3) of the potential changes on the sample surface on stretching shows that, by the destruction of the oxide film, an intense formation of anode segments occurs producing a maximum in the oscillogram. New microcells (oxide-film pores) formed at the same time effect a retardation of anodic polarization on the whole metal surface. The appearance of cracks causes the formation of a steadily increasing anodic segment. From a visual point of view, the propagation of cracks can be divided into 3 periods: (1) The incubation period (from the beginning of loading until the formation of cracks); (2) the period of uniform propagation of cracks (formation of hydrogen bubbles), and (3) the period of accelerated crack development (apparently of purely mechanical character). An increase in load shortens the first and second periods, and slightly ac-

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Comprehensive Investigation of Stress-Corrosion Cracking
Processes SOV/32-25-10-16/63

celerates the third one. The results obtained confirm the assumption of a film-electrochemical mechanism of stress corrosion cracking. There are 3 figures and 2 references, 1 of which is Soviet.

ASSOCIATION: Institut fizicheskoy khimii Akademii nauk SSSR (Institute of Physical Chemistry of the Academy of Sciences, USSR)

Card 3/3

5(4), 18(7)
AUTHORS:

Tomashev, N. D., Al'tovskiy, R. M.

SOV/76-33-3-17/41

TITLE:

Investigation of the Mechanism of Electrochemical Corrosion of Titanium (Issledovaniye mekhanizma elektrokhimicheskoy korrozii titana). I. Effect of the Halogen Ions Upon the Corrosion and Electrochemical Behavior of Titanium in Sulfuric Acid (I. Vliyaniye galoidnykh ionov na korrozionnoye i elektrokhimicheskoye povedeniye titana v sernoj kislotе)

PERIODICAL:

Zhurnal fizicheskoy khimii, 1959, Vol 33, Nr 3,
pp 610 - 616 (USSR)

ABSTRACT:

Recently several investigations have been carried out dealing with the corrosion properties of titanium, for titanium has properties well suited for construction material. The present paper deals with the effect of the Cl⁻, Br⁻ and J⁻ ions upon the behavior of Ti in sulfuric acid solutions. Cold-rolled titanium tin VT-1D (0.12% Fe, 0.022 - 0.025% H, 0.23 - 0.26% O, 0.05% Si and 0.017% N) was investigated. The experiments were carried out in the air and in hydrogen atmosphere. The rate of corrosion was

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Investigation of the Mechanism of Electrochemical
Corrosion of Titanium. I. Effect of the Halogen Ions Upon the Corrosion
and Electrochemical Behavior of Titanium in Sulfuric Acid

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determined according to the loss in weight and the halogen ions were added in form of their Na-salts. The experimental results obtained confirm the assumption that the corrosion behavior of Ti is determined by a coating of an oxide film on the metal. Thus, it is possible to explain observations as to a Ti-activation in diluted sulfuric acid in the presence of oxygen and a considerable potential shift towards more negative values in connection with a purification of the titanium surface. The addition of J^- -ions produced in several cases an increased corrosion resistance of titanium which is due to a passivation by the formation of a complex ion J_3^- . Cl^- - and Br^- - ions have a double effect; in diluted acid solutions where titanium is passivated they cause an activation; and in concentrated acid solutions with activated titanium they cause a passivation. The nature of the effect of Cl^- - and Br^- - ions depends on the state of the Ti-surface and the formation of an adsorption- or phase protective film respectively. There are 5 figures and 13 references, 6 of

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SOV/76-33-3-17/41
Investigation of the Mechanism of Electrochemical Corrosion of Titanium. I. Effect of the Halogen Ions Upon the Corrosion and Electrochemical Behavior of Titanium in Sulfuric Acid

which are Soviet.

ASSOCIATION: Akademiya nauk SSSR, Institut fizicheskoy khimii, Moskva
(Academy of Sciences, USSR, Institute of Physical Chemistry,
Moscow)

SUBMITTED: July 18, 1957

Card 3/3

SOV/20-124-6-29/55

5(2,4)
AUTHOR:Tomashov, N. D., Mikhaylovskiy, Yu. N.

TITLE:

Mechanism of Anodic Dissolution of Metals in Soils (Mekhanizm anodnogo rastvorenija metallov v pochvakh)

PERIODICAL:

Doklady Akademii nauk SSSR, 1959, Vol 124, Nr 6,
pp 1285 - 1288 (USSR)

ABSTRACT:

For the dissolution mentioned in the title as well as for
electrolytes the general equation holds:
$$\text{Me} \xrightarrow{\text{mH}_2\text{O}} \text{Me}^{+n} \cdot \text{mH}_2\text{O} + n\text{e}_0^-$$
, in which the primary stage
of the process is a migration of the metal ion into the soil
electrolyte. As far as the anodic process is accompanied
by a hydration of the forming metal ions the presence of
a certain amount of moisture in the soil is an indispensable
condition (Ref 1). Greater variations in the moisture of
natural soils may have a considerable influence upon the
rate of anodic metal dissolution. In this connection the
authors mention the investigation results of the aforesaid
process in the case of "Armko" iron in soils of different

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Mechanism of Anodic Dissolution of Metals in Soils

SOV/2o-124-6-29/55

moisture. Figure 1 gives anodic polarization curves obtained in the case of iron electrodes in sand with 1-20% moisture in which case the moisture was added in form of NaCl solution. From the results it can be seen that the stable potential of iron is shifted into the positive range in the case of decreasing soil moisture; the inhibitions of the anodic reaction increase. A similar dependence exists in loam soils. From the results obtained it can be seen that the density of the self-dissolution currents increases with decreasing soil moisture, i.e. in connection with making less complicate the cathodic process (Ref 1) whereas, the stable potential of iron is shifted on the general curve 1 into the positive range (Fig 1). Thus, the corrosion rate increases as calculated for the active (just moistened) anodic surface with decreasing soil moisture. If the this rate is calculated for the visible surface the former will increase only as long as the making less complicated at the cathodic process proceeds more rapidly than the shrinking of the active surface. In the case of a further decrease in moisture the entire rate of metal corrosion will decrease in consequence of the passivation of the basic surface of

Card 3/3

Mechanism of Anodic Dissolution of Metals in Soils SOV/2o-124-6-29/55

the metal. There are 3 figures, 1 table and 6 Soviet references.

ASSOCIATION: Institut fizicheskoy khimii Akademii nauk SSSR (Institute of Physical Chemistry of the Academy of Sciences, USSR)

PRESENTED: November 6, 1958, by V. I. Spitsyn, Academician

SUBMITTED: November 3, 1958

Card 3/3

5 (4)

AUTHORS:

Mirolyubov, Ye. N., Kurtepov, M. M.,
Tomashev, N. D. SOV/20-125-6-32/61

TITLE:

On Some Particular Features of the Cathode Process on
Stainless Steel in Solutions of Nitric Acid "(O nekotorykh
osobennostyakh katodnogo protessa na nerzhaveyushchikh
stalyakh v rastvorakh azotnoy kisloty)"

PERIODICAL:

Doklady Akademii nauk SSSR, 1959, Vol 125, Nr 6,
pp 1288-1291 (USSR)

ABSTRACT:

The processes mentioned in the title were investigated by plotting cathode-polarization curves (Fig 1). Investigations were carried out for chromium- and chromenickel steels containing niobium, and, for comparison, a platinum electrode. The dependence of corrosion on the potential is shown by figure 2. The following was found: The maximum current depends on the composition of the electrode; overvoltage in the cathode process is lower in the case of steel than in that of platinum. These phenomena are explained by a disturbance of passivation as a result of cathodic polarization followed by the formation of nitrous acid (as autocatalyst) by the reducing effect exercised by the substances removed

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On Some Particular Features of the Cathode Process on
Stainless Steel in Solutions of Nitric Acid SOV/20-125-6-32/61

from the steel upon the nitric acid. There are 2 figures and
11 references, 5 of which are Soviet.

ASSOCIATION: Institut fizicheskoy khimii Akademii nauk SSSR (Institute
for Physical Chemistry of the Academy of Sciences, USSR)
PRESENTED: January 24, 1959, by A. M. Frumkin, Academician
SUBMITTED: January 24, 1959

Card 2/2

5(4)

AUTHORS:

Tomashov, N. D., Isayev, N. I.

SOV/20-126-3-45/69

TITLE:

The Stability of the Passive State of Mechanical Stresses in
Metals (Ustoychivost' passivnogo sostoyaniya mekhanicheski
napryazhennogo metalla)

PERIODICAL:

Doklady Akademii nauk SSSR, 1959, Vol 126, Nr 3, pp 619-622 (USSR)

ABSTRACT:

It is said in the introduction to the present paper that the influence of mechanical stresses upon the electrode potential has hitherto been hardly investigated and that it may be seen from such publications as are available that mechanical stresses shift the electrode potential in the negative direction. It is looked upon as obvious that the variation of the cathode potential is caused by a variation of the internal energy of the metal; a corresponding equation is given with formula (1). For the case in which the thermal effect of deformation is low compared to the mechanical work of deformation, formula (2) is given for the variation of the cathode potential. The variations of the cathode potential are described as being very small on the basis of these formulas, even in the case of strong deformation, and they never exceed 3 - 5 mv. As experimental measuring values are higher, the destruction of the oxide film is considered to be a

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The Stability of the Passive State of Mechanical Stresses
in Metals

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further cause of the variation of the cathode potential in the case of further stresses. It is then said that the state of the oxide film determines the active or passive state of the metal, and that it is thus possible to investigate the influence exerted by mechanical stresses upon the passive state of the metal. The experiments were carried out on wire samples, and the alloys and their mechanical properties are given. As a corroding medium, a solution of NaNO_3 and $\text{K}_2\text{Cr}_2\text{O}_7$ is given. The results obtained are shown by diagrams. The first diagram (Fig 1) shows the variation with respect to time of the potential and of capacity in the primary passivation of carbon steel, and the second diagram (Fig 2) shows the same for stainless steel. It was found that, in the case of the carbon steel investigated, the potential goes over into the active state if the short-time stress causes a plastic deformation of the metal. In the case of the stainless steel investigated, only very slight activation is caused even in the case of mechanical stress being very high. Finally, it is shown that at the moment at which the stress is applied two factors become active in the metal. The one is

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The Stability of the Passive State of Mechanical Stresses
in Metals SOV/20-126-3-45/69

mechanical stress, which has an activating effect, the other is the oxidizing agent, which counteracts activation. After the decrease of the deformation of the oxide film, passivation by the solution predominates. There are 3 figures and 10 references, 6 of which are Soviet.

ASSOCIATION:

Institut fizicheskoy khimii nauk SSSR (Institute of Physical Chemistry of the Academy of Sciences, USSR)

PRESENTED:

February 11, 1959 by P. A. Rebinder, Academician

SUBMITTED:

January 29, 1959

Card 3/3

ROMASHOV, N. D.

"The corrosion and passivity of titanium."

report to be submitted at Gordon Research Conferences - New London, New Hampton, and Meriden, N.H., 13 June-2 Sep 60.

Institute of Physical Chemistry.

Tomasity, N.D.

PHASE I BOOK EXPLOITATION

87/303

REFUGES • 111

M. I. Borkov, Ed. of Publishing House; **S. I. Singer**; Tech.
Produstivo i obrabotka stali i spalov (Production and Treatment
of Steel and Alloys). Moscow: Metallurgizdat, 1960. 462 p.
(Series: Tsv. Sbornik, 39), 2,100 copies printed.

Glinkov, Professor; Doctor of Technical Sciences; N. N. Grigorash, Doctor, Candidate of Technical Sciences; V. P. Tselintsev, Professor, Doctor of Technical Sciences; A. M. Zuchkovskii, Professor, Doctor of Chemical Sciences; I. M. Klimin, Professor, Doctor of Technical Sciences; B. O. Lvovits, Professor, Doctor of Technical Sciences; A. P. Lubyshev, Professor, Doctor of Technical Sciences; I. M. Pavlov, Corresponding Member Academy of Technical Sciences USSR; and A. M. Polikarpov, Professor, Doctor of Technical Sciences.

purpose: This book is intended for technical personnel in industry, scientific institutions and schools of higher education, dealing with open-hearth and electric-furnace steaming, steel rolling, parallel metallurgy, metallography, and heat-treatment. It may end 1/10

also be used by students specializing in these fields.

All investigations of metallurgical and heat-engineering processes in open-hearth and electric furnaces. Data are included on the following: desulfurizing of pig iron outside the blast furnace; interpretation of oxides of the carbide-forming metals in the molten carbon; the change of content of gases in the bath of the open-hearth furnace in various periods of melting; intensification of the electric melting of steel, etc. Other articles deal with the nonuniformity of deformation in rolling, the study of the continuous rolling process, the dependence of the friction—slippage coefficients in rolling on a number of factors, and other problems in the processing of metal. Articles on physical metallurgy and the theoretical principles and techniques of the best treatment of steel are also included. No personnel titles are mentioned. References accompany most of the articles. There are 207 references, both Soviet and non-Soviet.

四〇

<p>Oronieksik, J. S., Doctor, Candidate of Technical Sciences, V. M. Iakunich, Engineer, and Ye. I. Shchukina, Engineer (Department of the Physics of Metals and X-Ray Analysis). Effect of Strain Histortisms and Aging on the Diffusion Rate in Nickel-Based Alloys</p>	381
<p>Tolokh, L. I., and O. S. Popov, Engineer (Department of Rolling). Investigation of the Deformation of Metal in Dragon-Al Beam Passes</p>	400
<p>Velina, R. T., Candidate of Technical Sciences (Department of Electroreactions). Magnetic Viscosity of High-Concreivity Alloys</p>	422
<p>Zemlyanikh, A. P., Doctor of Chemical Sciences, and N. P. Zhuk, and V. G. Kostylev, Candidates of Chemical Sciences (Department of Corrosion of Metals). Behavior of Iron and Steel in Oxidizing Solutions</p>	438
<p>Dyach, A. M., Doctor of Chemical Sciences, and L. Z. Korel', Candidate of Chemical Sciences (Department of Analytical Card 9/10</p>	

APPROVED FOR RELEASE: 04/03/2001 CIA-RDP86-00513R001756210008-1

Tomashov, N. D.

THE JOURNAL OF

1557

THE HISTORICAL JOURNAL OF THE AMERICAN REVOLUTION

Избранные работы по коррекции и коррекциям наяллов и гидроакустическим методам (Selected Papers on the Correction of Metals and Stress Corrosion of Metals) Moscow, Nauk. Mir, 1960. 350 pp., 3,000 copies printed.

Ed.: I.A. Luria, Candidate of Technical Sciences; Ed. of Publishing House:
Z.I. Kuznetsova, Radiomer; Tech. Ed.: V.D. Klyuchev; Moscow, 1958.

Editor-in-Chief: *Professor V. V. Kabanov*, Head of the Department of Instrument Engineering; Editorial Board: T. A. Lomidze, Candidate of Technical Sciences (Chairman), V. P. Astanin, Candidate of Technical Sciences, T. M. Bilibina, Candidate of Technical Sciences and A. V. Tikhonov, Candidate of Technical Sciences.

science.

CONTINUE: The collection contains discussions of heterogeneous corrosion or

which are added to the system and considered alike. The tendency of steel to develop various conditions of stress under certain conditions is discussed and the causes of corrosion and oxidation according to authorities. No permanent links are mentioned. Part of the article deals with methods of protection.

II. INVESTIGATIVE CONSIDERATION OF STABILIZERS

- | | |
|-----|--|
| 27 | Polarization, <i>J. A.</i> , Candidate of Technical Sciences, and S. V. Kostylev,
Institute of Ferrous Metallurgy, Moscow. Effect of Slip Service on the Tendency of Inhibition
and Acceleration of Water Oxidation by the Redox-Potential Method |
| 15 | Polarization, <i>J. A.</i> , Candidate of Technical Sciences, and Z. I. Tsvetkov,
Institute of Ferrous Metallurgy, Moscow. Study of the Tendency of Inhibition
and Acceleration of Water Oxidation by the Redox-Potential Method |
| 15 | Polarization, <i>P. I.</i> , Candidate of Technical Sciences, and N. M. Egorov,
Technical Sciences. Interpretation of Corrosion of
along the Fusion Line or Welded Joints of Zinc-Alloy Type
Stabilized Steels (Zn-Alloy Type Corrosion) |
| 79 | Polarization, <i>P. I.</i> , and L. P. Platonova. Effect of the Electric Heating
of the Zinc-Alloy Steel on the Processes Determining its Resistance
to Intergranular Corrosion |
| 79 | Perovskite, <i>I. A.</i> , Candidate of Technical Sciences, <i>L. P. Kostylev</i> ,
Institute of Ferrous Metallurgy, Moscow. Influence of Some Stainless Steels on Their
Effect on the Heat Treatment of New Stainless Steels on Their
Resistant Power. Intergranular Corrosion |
| 92 | Perovskite, <i>I. A.</i> , Candidate of Technical Sciences, and N. S. Kurnatova,
Institute of Ferrous Metallurgy. Influence of the Heat Treatment of
Stainless Steel on the Resistance of the Steel to
Intergranular Corrosion |
| 110 | Perovskite, <i>S. V.</i> , Candidate of Technical Sciences, and N. S. Kurnatova,
Institute of Ferrous Metallurgy. Influence of the Heat Treatment of
Stainless Steel on the Resistance of the Steel to
Intergranular Corrosion |
| 125 | Perovskite, <i>S. V.</i> , Candidate of Technical Sciences. Development of Two-Phase
Stainless Steel Effective Means of Increasing Stainless Steel Resistance to
Intergranular Corrosion |
| 125 | Perovskite, <i>S. V.</i> , Candidate of Technical Sciences. More on the Problem of the
Effect of Slippage Steel Intergranular Corrosion |
| 138 | Perovskite, <i>S. V.</i> , Candidate of Technical Sciences. Effect of Slip Service on the Tendency of Inhibition
and Acceleration of Water Oxidation by the Redox-Potential Method |
| 152 | Perovskite, <i>S. V.</i> , Candidate of Technical Sciences. Effect of Slip Service on the Tendency of Inhibition
and Acceleration of Water Oxidation by the Redox-Potential Method |

18.8300

27215
S/081/61/000/014/013/030
B103/B217

AUTHORS: Tomashov, N. D., Mikhaylovskiy, Yu. N.

TITLE: Electrochemical theory of underground corrosion of metals

PERIODICAL: Referativnyy zhurnal. Khimiya, no. 14, 1961, 332, abstract
14W182. (Tr. In-ta fiz. khimii. AN SSSR, 1960, vyp. 8,
190 - 216)

TEXT: The authors examined data on the effect of soil structure and properties (humidity, permeability) on cathodic and anodic processes in underground corrosion. It was found that the rate of uniform total corrosion I_{corr} of a metal in the soil can be calculated from the equation \times

$I_{corr} = K I_K I_a / (I_K + I_a)$, where K is a constant, I_K is the density of the cathodic limiting current at an iron electrode in the soil concerned (oxygen permeability of soil), I_a is the density of the anodic current at a given potential. The rate of local corrosion (δ) can be estimated from the oxygen permeability of soil I_K and from its resistance (ρ): $A I_K / \rho$,

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Electrochemical theory of...

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S/081/61/000/014/013/030
B103/B217

where A is a constant. The possibility of formation of large macrofields is determined by the equation $I = B \Delta I_K / \Delta l f^{-1}$, where B is a constant, $I_K / \Delta l$ is the change of oxygen permeability in a soil section of length Δl . On the basis of these assumptions a device for estimating the corrosive activity of soils was designed and constructed. [Abstracter's note: Complete translation.]

X

Card 2/2

TOMASHOV, N.D.; MIKHAYLOVSKIY, Yu.N.; LEONOV, V.V.

. Investigating the work of differential aeration couples in soils.
Trudy Inst.fiz.khim. 8:217-225 '60. (MIRA 14:4)

(Soil corrosion)

TOMASHOV, N.D.; KRASNOYARSKIY, V.V.; MIKHAYLOVSKIY, Yu.N.

Field testing of the corrosion of steels in oils. Trudy Inst.fiz.
khim. 8:226-234 '60. (MIRA 14:4)

(Steel—Corrosion)

(Soil corrosion)

TOMASHOV, N.D.; LUNEV, A.F.; IGNATOVA, Z.I.

Studying the protective properties of coatings by the capacitance-resistance method. Trudy Inst.fiz.khim. 8:254-263 '60.

(MIRA 14:4)

(Protective coatings—Testing) (Electric testing)

TOMASHOV, N.D.; LUNEV, A.F.; GEDGOVD, K.N.

Investigation of ion penetration and the porosity of protective
coatings by means of tagged atoms. Trudy Inst.fiz.khim. 8:264-
275 '60. (MIRA 14:4)

(Protective coatings—Testing) (Ions—Migration and velocity)
(Radioactive tracers)

TOMASHOV, N.D.; MIKHAYLOVSKIY, Yu.N.; LOPOVOK, G.G.

Testing of insulation coatings for cracking during flexure. Trudy
Inst.fiz.khim. 8:276-280 '60. (MIRA 14:4)

(Protective coatings—Testing)

KRASNOYARSKIY, V.V.; LUNEV, A.F.; TOMASHOV, N.D.

Field testing of protective coatings on underground pipelines.
7 Trudy Inst.fiz.khim. 8:281-290 '60. (MIRA 14:4)

(Pipelines--Corrosion) (Protective coatings--Testing)

TOMASHOV, N.D.; MIKHAYLOVSKIY, Yu.N.; LEONOV, V.V.

Kinetics of the deterioration of protective coatings on metals in
electrolytes. Trudy Inst.fiz.khim. 8:291-296 '60. (MIRA 14:4)

(Protective coatings) (Electrolytic corrosion)

TOMASHOV, N.D.; MIKHAYLOVSKIY, Yu.N.; LEONOV, V.V.

Kinetics of cathodic processes in the corrosion of metals under
protective coatings. Trudy Inst.fiz.khim. 8:297-304 '60.
(MIRA 14:4)

(Protective coatings)

(Electrolytic corrosion)

TOMASHOV, N.D., doktor khimicheskikh nauk; ZHUK, N.P., kand.khimicheskikh nauk; MIROLYUBOV, Ye.N., kand.khimicheskikh nauk

Behavior of iron and steel in oxidizing solutions. Sbor.
(MIREA 13:7)
Inst.stali no.39:438-449 '60.

1. Kafedra korrozii metallov Moskovskogo ordena Trudovogo
Krasnogo Znameni instituta stali im. I.V.Stalina.
(Iron--Corrosion) (Steel--Corrosion)
(Oxidizing agents)

TOMASHOV, N.D.; AL'TOVSKIY, R.M.; KUSHNEREV, M.Ya.

Method for removing thin oxide films from titanium surfaces and study
of their structures. Zav.lab. 26 no.3:298-301 '60. (MIRA 13:6)

1. Institut fizicheskoy khimii Akademii nauk SSSR.
(Titanium oxides)

18.8310

27514
S/080/60/033/006/019/041/XX
D217/D302

AUTHORS: Tomashov, N.D., Chernova, G.P., and Markova, O.N.

TITLE: Influence of anodic polarization on the intercrystalline corrosion of stainless chromium-nickel steels

PERIODICAL: Zhurnal prikladnoy khimii, v. 33, no. 6, 1960,
1324 - 1334

TEXT: The possibility of protecting steels against general and intercrystalline corrosion by means of anodic polarization in sulphuric acid solutions and in solutions used for testing the tendency to intercrystalline corrosion, was investigated. The material tested was 2X18H9 steel (2Kh18N9) (free from titanium), containing 0.15 - 0.25 % C. This steel, as quenched from 1050° and subsequently tempered at 650° for 2 hours, is known to be liable to fail by intercrystalline corrosion. Untempered, however, it does not tend to fail by this mechanism. This steel was therefore tested in both conditions. The tendency to failure was determined after boiling in a solution of the following composition: 160 g

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Influence of anodic polarization ... D217/D302

$\text{CuSO}_4 \cdot 5\text{H}_2\text{O} + 100 \text{ cm}^3 \text{H}_2\text{SO}_4$ (s.g. = 1.84) + 1000 ml H_2O with addition of copper filings. The behavior of the stainless steel 2Kh18N9 was investigated in the above range of potentials (from - 0.13 - +1.3 V) in order to study its corrosion behavior and develop methods of protecting it against intercrystalline corrosion. The study of the influence of anodic polarization on intercrystalline corrosion was carried out by plotting polarization curves by potentiostatic methods and by corrosion tests at given potentials. It was found that the range of the stable, passive condition of quenched and tempered 2Kh18N9 steels in sulphuric acid solutions lies between + 0.51 and + 0.83 V. In the tempered condition, this range reduces to 0 to + 0.4 V. In the stable, passive state, this steel, whether tempered or quenched, resists failure by intercrystalline corrosion in sulphuric acid solutions, the general corrosion is extremely slight and anodic protection in this case is possible. With an increase in aggressiveness of the medium, the stable, passive range of the tempered steel is reduced to a greater extent than that of quenched steel, and in a strongly aggress-

X

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S/080/60/033/006/019/041/XX
D217/D302

Influence of anodic polarization ...

sive medium may be entirely absent. In the transpassivity region, the tempered steel is liable to fail by intercrystalline corrosion, whereas the quenched steel is not. Protection against intercrystalline corrosion in the passive potential range by means of anodic polarization is possible both in the copper sulphate-base testing solution and in solutions containing 10 % HNO_3 + 1 or 2 % NaF . There are [redacted] figures, 4 tables and 10 references: 8 Soviet-bloc and 2 non-Soviet-bloc. The reference to the English-language publication reads as follows: R. Edelenau, *Nature*, 17, 739, 1954.

SUBMITTED: November 24, 1959

X

Card 3/3

80232
S/076/60/034/04/22/042
B010/B009

5.4600

AUTHORS:

Tomashov, N. D., Paleolog, Ye. N., Fedotova, A. Z. (Moscow)

TITLE:

Electrochemical and Corrosion Behavior of Semiconductors in Electrolyte Solutions. I. Electrode Processes on Germanium in Sulfuric Acid Solutions in the Presence of Hydrogen Peroxide

PERIODICAL: Zhurnal fizicheskoy khimii, 1960, Vol. 34, No. 4, pp. 833 - 840

TEXT: Since germanium is the electron semiconductor now most frequently used the kinetics of the electrode processes of germanium monocrystals of the n- and p-types in sulfuric acid solutions with different hydrogen peroxide contents was investigated in the present paper. The samples were polished or etched in an SR-4 solution ($15 \text{ cm}^3 \text{ CH}_3\text{COOH}$, $25 \text{ cm}^3 \text{ HNO}_3$, $15 \text{ cm}^3 \text{ HF}$, and $0.06 \text{ cm}^3 \text{ Br}_2$). The curves of cathodic polarization (Fig. 1) of n-type germanium show that this material behaves, in principle, like a metal electrode. With regard to the discharge of hydrogen ions n-germanium is not an effective cathode and exhibits a high hydrogen supersaturation. Table 1 shows the change in the hydrogen peroxide concentration of a sulfuric acid solution ($\text{pH} = 1$) + $0.11 \text{ M H}_2\text{O}_2$ in the cathodic

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Electrochemical and Corrosion Behavior of Semiconductors
in Electrolyte Solutions. I. Electrode Processes on
Germanium in Sulfuric Acid Solutions in the Presence of
Hydrogen Peroxide

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polarization of n-germanium in the presence of air at 25°C. The process continues until H_2O_2 is reduced, and the cathodic polarization of germanium is greatly decreased. The cathodic polarization of p-germanium is more inhibited than that of n-germanium, i.e., the H_2O_2 reduction as well as the hydrogen ion discharge. This may be due to an additional potential drop on account of the reduction of the number of holes in p-germanium, so that the principal role in the reduction reaction on p-germanium is played by the electrons in the zone of valency. The anodic behavior of p-germanium differs from that of n-germanium. The anodic dissolution on p-germanium is similar to that on normal metal. With current densities up to

30 ma/cm² p-germanium remains active in all solutions and dissolves into Ge⁴⁺. The velocity of delivery of the holes to the surface of n-germanium may be regarded as determining the anodic dissolution process of n-germanium. This results in a marked ability of the electrode to be polarized and in the occurrence of an anodic saturation current whose magnitude is independent of the composition of the solution and increases when the electrode is exposed to light. There are

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Electrochemical and Corrosion Behavior of Semiconductors
in Electrolyte Solutions. I. Electrode Processes on
Germanium in Sulfuric Acid Solutions in the Presence of
Hydrogen Peroxide

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B010/B009

5 figures, 2 tables, and 7 references, 1 of which is Soviet.

44

ASSOCIATION: Akademiya nauk SSSR Institut fizicheskoy khimii (Academy of
Sciences USSR Institute of Physical Chemistry)

SUBMITTED: July 4, 1958

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S/076/60/034/05/14/038
B010/B002

5.4600

AUTHORS: Paleolog, Ye. N., Tomashov, N. D., Fedotova, A. Z.

TITLE: Electrochemical and Corrosion Behavior of Semiconductors in Electrolyte Solutions. II. The Rate of Solution of Germanium in Sulfuric Acid in the Presence of Hydrogen Peroxide

PERIODICAL: Zhurnal fizicheskoy khimii, 1960, Vol. 34, No. 5,
pp. 1027-1031

TEXT: The dissolution of germanium in electrolyte solutions has not yet been investigated systematically though this problem is of special importance for the production of semiconductors, i.e., for the etching of the surface of germanium. In the present paper, the authors studied the dissolution of n-type and p-type germanium in H_2SO_4 (pH=1), H_2SO_4 (pH=1) + $0.12\text{ M } H_2O_2$ and $8.8\text{ M } H_2O_2$. The solution was carefully mixed, and the rate of dissolution was determined at $25^\circ C$ by a colorimetric determination of the germanium content of the solution in certain intervals. The analyses were carried out by L. S. Kupriyanova. The results obtained (Table) show that the rate of dissolution is independent of the type of germanium (n-type or p-type) and rises in the presence of H_2O_2 . Furthermore, it changes little in time. A cathodic or anodic polarization of the germanium electrode

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Electrochemical and Corrosion Behavior of
Semiconductors in Electrolyte Solutions.
II. The Rate of Solution of Germanium in
Sulfuric Acid in the Presence of Hydrogen
Peroxide

S/076/60/034/05/14/038
B010/B002

leads to a decrease in the rate of dissolution. On the strength of the results obtained the authors establish that under the present experimental conditions the dissolution of germanium has an electrochemical nature. As the dissolution of n-type germanium by means of H_2O_2 is raised with the same intensity as in the case of p-type germanium, it is assumed that on the surface of n-type germanium the concentration of holes is higher, and that the cathodic process is facilitated by the reduction of hydrogen peroxide. There are 2 figures, 1 table, and 4 references: 1 Soviet, 2 German, and 1 American.

ASSOCIATION: Akademiya nauk SSSR Institut fizicheskoy khimii
(Academy of Sciences of the USSR, Institute of Physical Chemistry)

SUBMITTED: August 4, 1958

Card 2/2

84248

1018

1145

54600

1153

S/076/60/034/009/008/022

B015/B056

AUTHORS:

Deryagina, O. G., Paleolog, Ye. N., and Tomashov, N. D.

TITLE:

Electrochemical and Corrosion Behavior of Semiconductors
in Electrolytic Solutions. III. Dissolution of Germanium
in Contact With Other Metals

PERIODICAL:

Zhurnal fizicheskoy khimii, 1960, Vol. 34, No. 9,
pp. 1952-1959

TEXT: In the fusion of n-type germanium with indium, a narrow band of a p - n junction may be obtained. If electric contacts (Cu wires) are soldered onto the germanium and indium with tin, and if the whole is insulated against air/with the exception of the free Cu wire ends (e.g., with an epoxy resin shell), a plate cathode Ge - In - Sn - Cu is obtained (Fig. 1). As the surface of this diode is edged before being embedded into the resin shell, the electrochemical behavior of Ge in the many-electrode system Ge - In - Sn - Cu was investigated, and the mechanism of its dissolution was explained. The experiments were carried out in 1 N NaOH solutions of different H₂O₂ contents (0.3 N H₂O₂ and 1.0 N H₂O₂), or in pure

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Electrochemical and Corrosion Behavior of
Semiconductors in Electrolytic Solutions.
III. Dissolution of Germanium in Contact With
Other Metals

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B015/B056

17.5 N H_2O_2 solutions. Samples of n-type Ge (of the type $\Delta M(DM)$ or $\delta M(BM)$), In, Cu, and Sn embedded in polystyrene¹⁵, as well as pairs of n-type Ge-Cu and n-type Ge-In, and ready diodes (of the type $\Delta G\bar{U}-22$ (DGTs-22)) were used. The area of the electrodes in the diodes investigated are given in Table 1. The corrosion current of Ge, as well as the quantity of the dissolved Ge were determined by a colorimetric method (Ref. 7); the surface profile of Ge was measured by means of a microscope, or the current density and dissolution rate of Ge (in the pair Ge-Cu) was calculated from the polarization diagram. A comparison between the experimental data and the calculated values (Table 2) shows that a self-dissolution of Ge takes place, and that the latter increases with the H_2O_2 content.

In the many-electrode system investigated, Ge is the anode and Cu is the most effective cathode, whereas Sn and In are highly polarized and, according to conditions, act as a cathode or anode. The total loss of n-type Ge (Table 3, Ge-Cu loss) in contact with Cu, In, and Sn is determined by the rate of anodic dissolution or self-dissolution, the ratio between

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84248

Electrochemical and Corrosion Behavior of
Semiconductors in Electrolytic Solutions.
III. Dissolution of Germanium in Contact With
Other Metals

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B015/B056

the two rates depending on the H₂O₂ content (Table 4), i.e., self-dis-
solution predominates in pure H₂O₂ solutions. The behavior of n-type Ge
during etching in the afore-mentioned solutions corresponds to the
activity of the Ge electrode in the system Ge - In - Sn - Cu, and is
subject to electrochemical rules. There are 6 figures, 4 tables, and
8 references: 7 Soviet and 1 US.

ASSOCIATION: Akademiya nauk SSSR, Institut fizicheskoy khimii, Moskva
(Academy of Sciences USSR, Institute of Physical Chemistry,
Moscow)

SUBMITTED: December 13, 1958

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Card 3/3

81732

S/020/60/133/01/47/070
B004/B007*5.4600*AUTHORS: Paleolog, Ye. N., Korotkova, K. S., Tomashev, N. D.TITLE: The Kinetics of the Electrode Processes on a Silicon
Electrode in Acid and Alkaline SolutionsPERIODICAL: Doklady Akademii nauk SSSR, 1960, Vol. 133, No. 1,
pp. 170 - 173

TEXT: The authors investigated the discharge rate of hydrogen ions on silicon and the anodic dissolution rate of silicon in 0.2 N H_2SO_4 , 1.0 N HF, and 5.0 N KOH at 25°C. n- and p-type single crystals of silicon with different resistivity (0.2, 10.0, and 23.0 ohm.cm) and a diffusion length of 0.5 mm were used for the investigation. The samples had the same crystal orientation. The surface was mechanically ground by means of boron carbide or etched at 80°C with a KOH-solution. Contact was established by means of rhodium electrolytically deposited on the sample and a soldered-on copper wire. Fig. 1 shows the curve of the cathodic polarization of n-type Si. In H_2SO_4 a considerable inhibition of the

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81732

The Kinetics of the Electrode Processes on a
Silicon Electrode in Acid and Alkaline Solutions

S/020/60/133/01/47/070
B004/B007

H-ion discharge was observed also on Si with a ground surface. The presence of a semiconductive oxide layer is assumed, which proved that by means of a partial reduction of the layer with current reversal, and further by etching the KOH, polarization is considerably reduced. In 5.0 N KOH the oxide layer is soluble, the discharge rate of the H-ions depends only little on the resistivity of the Si-electrode, and the n-type Si behaves like a metal electrode. Fig. 2 shows the curve of the cathodic polarization of p-type silicon. Polarization is stronger than in n-type Si, the nature of the solution exerts little influence upon the kinetics of H-ion discharge. The anodic polarization is shown in Fig. 3. In H_2SO_4 , the oxide layer is not soluble and has a high degree of ohmic resistivity. Si is highly polarized, and oxygen is separated. The presence of the oxide layer is proved by grinding-off the silicon electrode during the experiment. In this case, the slope of the polarization curve was considerably flattened up to a current density of 15 ma/cm². In the case of higher current densities, the oxide layer could not be completely removed. In 1.0 N HF, a different behavior of n- and p-type Si was observed. p-type Si was not passivated up to a current density of

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81732

The Kinetics of the Electrode Processes on a
Silicon Electrode in Acid and Alkaline Solutions

S/020/60/133/01/47/070
B004/B007

30 ma/cm². In the case of n-type Si, a hindrance of the anodic process occurred already at 1.0 ma/cm², which is explained by the hole limiting current being attained. The electrochemical behavior of silicon thus in electrolytes is in principle similar to that of germanium, and is determined by the type of conductivity. Silicon, however, differs from germanium by the formation of the chemically inactive SiO₂-layer with high ohmic resistivity which hinders the cathodic and anodic reactions. There are 3 figures and 6 references: 2 Soviet, 3 British, and 1 German.

ASSOCIATION: Institut fizicheskoy khimii Akademii nauk SSSR (Institute of Physical Chemistry of the Academy of Sciences, USSR)

PRESENTED: March 3, 1960 by A. N. Frumkin, Academician

SUBMITTED: March 3, 1960

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Card 3/3

Tomashev, N.D.

81865

5.4600
24.7700

S/020/60/133/02/39/068
B004/E064

AUTHORS:

Deryagina, O. G., Paleolog, Ye. N., Tomashev, N. D.

TITLE:

Anodic Dissolution of Germanium With a p-n Transition

PERIODICAL:

Doklady Akademii nauk SSSR, 1960, Vol. 133, No. 2,
pp. 388 - 391

TEXT: The objective of the present paper was to determine the conditions for a selective etching of the p-n transitions of germanium taking into account the electrochemical processes of the diode components at the boundary of the solution. The authors investigated the distribution of the potential, the current density, and the dissolving speed in the components of a germanium diode at various anodic polarizations. Indium-germanium diodes were used for the test in which germanium of the ΔM type, as well as a germanium single crystal with p-n transition were applied. The samples were embedded in epoxy resin and ground at a right angle to the In-Ge contact plane. They were then polished and after etching in H_2O_2 they were anodically polarized in 0.1 N NaOH or

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B004/B064

Anodic Dissolution of Germanium With a
p-n Transition

0.1 N H_2SO_4 at room temperature and in dispersed daylight. The positive pole of the circuit was connected to the indium. The potential distribution was measured with a capillary detector, the depth of the solution (the profile of the surface) with a Linnik double microscope. The width of the zone of p-type germanium was determined by the precipitation of copper with cathodic polarization of the p-n transition in pyrophosphate solution. Fig. 1 shows the curve of the anodic polarization of indium, p- and n-type germanium in 0.1 N NaOH. A strong polarization occurs in In and n-Ge. In contrast to In the high degree of polarization of n-type germanium is not due to passivity but to the low degree of hole concentration. Fig. 2 shows the potential distribution on the surface of the diode at an anode current of 0.05 - 4.00 ma, Fig. 2b shows the surface profiles after 60 min. and Fig. 2v gives the amperages obtained. The current density of n-Ge is greater than that of the anode current on the boundary of the solution. In the authors' opinion this is due to the injection of holes in n-Ge above the p-n transition. This is confirmed by Fig. 3 which shows that the anodic polarization of the n-Ge surface decreases as the distance from the

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Anodic Dissolution of Germanium With a
p-n TransitionS/020/60/133/02/39/068
B004/B064

p-n transition increases. This is due to a decreased concentration of the injected holes. If the germanium diode is anodically polarized from indium a high degree of anodic polarization of indium occurs and it is above all the p-Ge and the adjacent zones of n-Ge which dissolve. With a cathodic polarization from n-Ge its dissolution can be stopped and concentrated to the narrow zone of p-Ge. Indium is not polarized in H_2SO_4 and mainly indium and the adjacent zone of p-type germanium are dissolved. Similar results were obtained with the germanium single crystal. Because of the different anodic polarizability of n-Ge, p-Ge, and In and because of the existing p-n transition a selective etching of a germanium diode or triode is possible. There are 3 figures and 9 references: 4 Soviet, 1 American, 3 British, and 1 German.

ASSOCIATION: Institut fizicheskoy khimii Akademii nauk SSSR (Institute of Physical Chemistry of the Academy of Sciences, USSR)

PRESENTED: February 3, 1960, by A. N. Frumkin, Academician

SUBMITTED: March 2, 1960

Card 3/3

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TOMASHOV, Nikon Danilovich; ZHUK, Nikolay Platonovich; TITOV, Vasiliy Alekseyevich; VEDENEYEVA, Mariya Aleksandrovana; EL'KIND, L.M., red. izd-va; ISLENT'YEVA, P.G., tekhn. red.

[Laboratory work on the protection of metals from corrosion] Laboratornye raboty po korrozii i zashchite metallov. Moskva, Gos. nauchno-tekhn. izd-vo lit-ry po chernoi i tsvetnoi metallurgii, 1961. 239 p. (MIRA 14:7)

(Metals—Corrosion)

32624
8/137/61/000/011/102/123
A060/A101

18.8300

AUTHORS: Vedeneyeva, M.A., Tomashov, N.D.

TITLE: Effect of deformation upon the intercrystalline failure of nichrome steel

PERIODICAL: Referativnyy zhurnal. Metallurgiya, no.11, 1961, 48-49, abstract 111323 (v sb. "Korroziya i zashchita konstrukts. metallich. materialov", Moscow, Mashgiz, 1961, 116 - 126)

TEXT: The authors studied the effect of deformation caused by cold rolling and dressing of the surface by emery paper upon the intercrystalline failure of Cr-Ni steel. The steels OX18H9, 1X18H9, and X23H23M3Д3 (OKh18N9, 1Kh18N9, and Kh23N23M3D3) were tested. The cold deformation (rolling) with degrees of reduction 20-60% was carried out both before and after tempering at 650°C for 2 hours. As result of the treatment the tendency of these steels to intercrystalline failure is reduced. This is related to the fact that in the process of deforming along the cleavage planes carbides and the α -phase separate out. The carbide phase which is precipitated in the course of tempering and deformation, separates out on a great area and its concentration is reduced. As result of this,

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A060/A101

Effect of deformation ...

the corrosion resistance of the boundaries increases. The deformation of steel before tempering (in the zone of dangerous temperatures) lowers the tendency to intercrystalline corrosion in a greater degree than does deformation after tempering. Cold deformation before tempering at 650° entirely eliminates the tendency of steel Kh23N23M3D3 to intercrystalline cracking under reductions of 21 - 60%, and that of steels OKh18N9 and 1Kh18N9 - under reductions of 49 and 58% respectively. The rate of intercrystalline etching of specimens of steel 1Kh18N9 with etched surface notably exceeds the corrosion rate of the specimens dressed with emery paper. There are 10 references.

Ye. Layner

[Abstracter's note: Complete translation]

Card 2/2

18-8300

32623
S/137/61/000/011/101/123
A060/A101AUTHORS: Tomashev, N.D., Andreyev, L.A.

TITLE: Oxidation of titanium at high temperatures

PERIODICAL: Referativnyy zhurnal. Metallurgiya, no. 11, 1961, 46, abstract
111308 (V sb. "Korroziya i zashchita konstrukts. metallich. materi-
alov", Moscow, Mashgiz, 1961, 127 - 132)

TEXT: A study was performed of the oxidation kinetics of Ti mark BT-1Д (VT-1D) in the interval 800-1,150°C in gaseous mixtures of O₂+N₂ in various proportions. Under soakings longer than one hour the oxidation follows a linear law in the entire temperature range under investigation. For 1,000°C a functional dependence was obtained of the oxidation-rate constant, characterizing the linear portion of the kinetic curve, on the partial pressure of O in the gaseous mixture. The kinetics of O dissolution in the metallic base was studied for the temperature of 1,000°C. It is assumed that the oxidation process is controlled by the O diffusion into the metallic base of the specimen. There are 8 references. X

[Abstracter's note: Complete translation]

Ye. Layner

Card 1/1

S/081/61/000/022/032/076
B110/B101

AUTHORS: Tomashev, N. D., Mil'vidskiy, M. G.

TITLE: Etching of titanium in acid solutions and alkali melts

PERIODICAL: Referativnyy zhurnal. Khimiya, no. 22, 1961, 259, abstract 22I182 (Sb. "Korroziya i zashchita konstrukts. metallich. materialov". M., Mashgiz, 1961, 133 - 150)

TEXT: A study of the possibilities of etching Ti in H_2SO_4 , HCl (acid), and HNO_3 with fluoride additions showed the etching efficiency of industrial Ti scale to depend on the oxidation temperature. Scale forming at 800 - 850°C was chemically stable to acids, but was sufficiently easy to remove at >1000°C. The anodic and cathodic behavior of Ti in the acids mentioned, and in HF containing admixtures, was studied. For etching Ti in alkali melts ($NaOH$ melt), a 10 - 20 min treatment at 400-430°C and subsequent washing in hot 15% H_2SO_4 are recommended. [Abstracter's note: Complete translation.]

Card 1/1

33843
S/137/62/000/001/186/237
A006/A101

18.8300

AUTHORS:

Tomashev, N.D., Al'tovskiy, R.M., Prosvirin, A.V., Shamgunova, R.D.
Corrosion of titanium and its alloys in sulfuric acid

TITLE:

Referativnyy zhurnal. Metallurgiya, no. 1, 1962, 82 - 83, abstract
11583 (V sb. "Korroziya i zashchita konstrukts. metallich. materia-
lov", Moscow, Mashgiz, 1961, 151 - 163)

PERIODICAL:

The general aspect of BT 1 (VT1) Ti corrosion rate as a function of
 H_2SO_4 concentration under air atmosphere is also preserved in tests under O_2 , H_2
and N_2 atmospheres and also during tests of some Ti alloys (VT5, VT3, VT3-1) under
air atmosphere. The corrosion rate of Ti VT1 in H_2SO_4 under atmospheres of O_2 ,
 H_2 and N_2 (with the exception of diluted H_2SO_4 solutions) is somewhat less than
under air atmosphere. Alloys Ti VT5, VT3 and VT3-1, are in general somewhat less
stable than technically pure VT1 Ti in H_2SO_4 solutions. Saturation of the Ti sur-
face with oxygen, and in particular N_2 and H_2 , raises considerably the corrosion
resistance of Ti in H_2SO_4 . Preliminary hydrogenation of the Ti surface by
cathodic polarization during self-diffusion in H_2SO_4 , inhibits the corrosion
process of Ti dissolving in H_2SO_4 , in particular of 50 - 65% concentration. A

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33843
S/137/62/000/001/186/237
A006/A101

Corrosion of titanium ...

decrease of the Ti corrosion rate in H_2SO_4 of > 80% concentration is explained by the oxidation of the metal surfaces by concentrated acid and the formation of a protective film consisting of Ti^{3+}_5 .

The authors' summary

[Abstracter's note: Complete translation]

Card 2/2

S/081/61/000/023/028/061
B138/B101

AUTHORS:

Tomashov, N. D., Al'tovskiy, R. M., Vladimirov, V. B.

TITLE:

Investigation of the corrosion of titanium and its alloys
in solutions of bromine and methyl alcohol

PERIODICAL:

Referativnyy zhurnal. Khimiya, no. 23, 1961, 288,
abstract 23I255 (Sb. "Korroziya i zashchita konstrukts.
metallich. materialov". M., Mashgiz, 1961, 164 - 172)

TEXT: An investigation of the corrosion resistance of Ti and Ti alloys in
solutions of Br in CH₃OH has shown that alloys with an α -structure, BT1
(VT1) and BT5 (VT5), are less resistant than those with an $\alpha + \beta$ structure,
BT3 (VT3) and BT3-1 (VT3-1). It is noted that in all the Ti alloys the
rate of corrosion increased with the Br₂ concentration of the solution,
and that Ti iodide is more stable than technically pure Ti. An addition
of water to the CH₃OH + Br₂ was found to reduce the rate of corrosion, due
to the formation of a protective oxide film. Ti is also subject to

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S/081/61/000/023/028/061

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Investigation of the corrosion...

intercrystalline corrosion, which increases with a reduction of the Br_2 concentration in CH_3OH from 5 to 1 %. If the water content of the solution is more than 30 %, however, both intercrystalline and general surface corrosion cease. The corrosion of Ti in $\text{Br}_2 + \text{CH}_3\text{OH}$ solutions is found to be of an electrochemical nature. In anhydrous solutions Ti can be protected by cathode polarization. For total protection in a 2% solution of Br_2 the potential must be maintained at around -0.350 v.

[Abstracter's note: Complete translation.]

Card 2/2

33844
S/137/62/000/001/187/237
A006/A101

18.8300

AUTHORS: Tomashov, N. D., Al'tovskiy, R. M., Chernova, G. P., Artyeyev, A. D.

TITLE: Corrosion resistance of titanium alloyed with molybdenum, chromium and palladium

PERIODICAL: Referativnyy zhurnal, Metallurgiya, no. 1, 1962, 83, abstract 11584
(V sb. "Korroziya i zashchita konstrukts. metallich. materialov",
Moscow, Mashgiz, 1961, 173 - 186)

TEXT: Alloying of Ti with palladium raises considerably its corrosion resistance in H_2SO_4 and HCl. Considerable reduction of the Ti corrosion rate is already observed when it is alloyed with a small Pd amount (0.1%). An increase of the Pd content in the alloy > 2% is not recommended. Electrochemical investigations have shown that an increase in the Ti corrosion resistance when it is alloyed with Pd, results from the shift of the stationary potential of the alloy to a range of values where Ti is partially or fully passive, due to the reduced overvoltage of the cathodic reaction. Alloying of Ti with molybdenum increases Ti resistance due to the considerably reduced ability of the alloy to anodic dissolving as compared with non-alloyed Ti. Alloying of Ti with chromium does not

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33844

Corrosion resistance of titanium alloyed with...

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A006/A101

raise its corrosion resistance, and even reduces same in some cases, since Cr is less prone to passivity than Ti in H_2SO_4 and HCl, at a potential corresponding to a stationary potential of Ti. Ternary Ti-Pd-Mo alloys and Ti-Pd-Cr alloys are more resistant than the binary Ti-Pd alloy. This is due to a decrease in the current of anodic Ti dissolving near the potential of full passivation, when it is alloyed with Mo or Cr. There are 17 references.

X
Author's summary

[Abstracter's note: Complete translation]

Card 2/2

18.8380

33842
S/137/62/000/001/185/237
A006/A101

AUTHORS: Titov, V.A., Agapov, G.I., Tomashev, N.D.

TITLE: Corrosion of tantalum, niobium and their alloys in sulfuric acid at high temperatures

PERIODICAL: Referativnyy zhurnal. Metallurgiya, no. 1, 1962, 82, abstract 11581
("Korroziya i zashchita konstrukts. metallich. materialov", Moscow,
Mashgiz, 1961, 187 - 195)

TEXT: The authors studied the behavior of Ta, Nb and their alloys, containing 21.6; 34.0; 49.4; 67.3 at. % Ta, in H_2SO_4 at high temperature. In 90% H_2SO_4 , at 250°C, during the transition from an alloy containing 34.0 at. % Ta to an alloy containing 49.4 at. % Ta, an over 30-fold decrease of the corrosion rate was observed (from 15.1 to 0.5 g/m².hour) and also an abrupt change of the potential toward the positive side (from 0.25 to 0.77 v, i.e. more than by 0.5 v). The abrupt changes in the anti-corrosion properties of the alloy correspond to the first threshold of stability in the Ta and Nb correlation, equal to 4/8 atomic fraction. Extended tests (120 hours) of Ta-Nb alloys under experimental conditions, do not shift the threshold of stability towards the rate of other Ta-Nb

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33842
S/137/62/000/001/185/237
A006/A101

Corrosion of tantalum

correlations in the alloy. In 10% H₂SO₄ at boiling temperature of the solution (102°C), the internal stresses (cold hardness) shift the electrode potential of the alloys to the negative side, by 0.05 v on the average, but both cold hardness and stress applied do not reduce the corrosion resistance nor cause corrosion cracking of the alloys. Tests with the Ta-Nb alloy containing 96.2 at.% Ta in various H₂SO₄ solutions at 250°C, have shown that 70% H₂SO₄ is the most aggressive medium as compared with its solutions of other concentrations. There are 11 references.

The author's summary

[Abstracter's note: Complete translation]

Card 2/2

18.8300

33838
S/137/62/000/001/180/237
A006/A101

AUTHORS: Tomashev, N. D., Strekalev, P. V.

TITLE: Investigating the corrosion rate of ferro-carbon alloys in acids at elevated temperatures

PERIODICAL: Referativnyy zhurnal, Metallurgiya, no. 1, 1962, 80 - 81, abstract 11569, ("Korroziya i zashchita konstrukts. metallich. materialov", Moscow, Mashgiz, 1961, 196 - 199)

TEXT: Increased temperature of acid causes a sharp increase of the corrosion rate of Fe-C alloys; the corrosion rate increases also at a higher C content in the alloy in non-oxidizing acids, and in oxidizing acids it decreases due to the partial inhibition of the anodic process. The effect of temperature on the diffusion rate of carbon steels in HCl, HNO₃ and H₂SO₄, can be described by the exponential equation K = Aexp (- E/RT). The authors determined the activation energy of processes of carboc-steel diffusion in HNO₃, H₂SO₄ and HCl. For HNO₃ the activation energy is equal to 10.5 kcal, for H₂SO₄ and HCl it is 13.5 and 17.35 kcal, respectively.

[Abstracter's note: Complete translation]

Author's summary

X

Card 1/1

31966
S/081/61/000/023/031/061
B138/B101

18.8310

AUTHORS:

Titov, V. A., Balandin, I. M., Tomashov, N. D.

TITLE:

Investigation of the efficiency of different methods of protecting metals in solutions of sulfuric and phosphoric acids at elevated temperatures

PERIODICAL:

Referativnyy zhurnal. Khimiya, no. 23, 1961, 290, abstract 231276 (Sb. "Korroziya i zashchita konstrukts. metallich. materialov". M., Mashgiz, 1961, 200 - 214)

TEXT: The effect of cathodic (As and Bi ions) and anodic (Cu, Ag, and Au ions) corrosion inhibitors has been investigated, as also electrolytic protection by anodic polarization. Cu, Ag, and Au depositions and Ag and Au contact, on the rate of corrosion of stainless steels 1X18H9T (1Kh18N9T) and X23H28M3D3T (Kh23N28M3D3T) in 10% solutions of H_2SO_4 and H_3PO_4 at a temperature of 250°C. The cathodic corrosion inhibitor, Bi, has been found to have the greatest inhibiting effect for stainless steels in H_2SO_4 . Corrosion of the Ni

Card 1/2

Investigation of the efficiency...

31966
S/081/61/000/023/031/061
B138/B101

alloy is more effectively reduced if it has a Cu coating. In H_3PO_4 an addition of Ag ions to the acid solution is the most efficient way of reducing corrosion of the stainless steels and the Ni alloy. [Abstracter's note: Complete translation.]

X

Card 2/2

S/137/62/000/001/201/237
A154/A101

AUTHORS: Titov, V. A., Tomashov, N. D.

TITLE: A study of the endurance of card wire

PERIODICAL: Referativnyy zhurnal, Metallurgiya, no. 1, 1962, 87, abstract II616
(Sb. "Korroziya i zashchita konstrukts. metallich. materialov".
Moscow, Mashgiz, 1961, 215-222)

TEXT: Steel brands 55, 50T (50G), 50TC (50GS), 50Ti and 60 were studied. Steel 55 has the best fatigue and corrosion-fatigue indices. For wire made of this steel $\sigma_w = 25 \text{ kg/mm}^2$ was obtained in air. When high stresses are applied, wire made of steel 55 has a fatigue resistance over 50 to 90 times higher than wire of steel 50Ti and 60 respectively. At comparatively low stresses, the fatigue-resistance indices of wire made of steels 55, 50Ti and 60 become close to each other. The endurance of wire made of the test brands of steel in tap water decreases to such a degree that even for the best wire made of steel 55, at the lowest stress tested by us (25 kg/mm^2), the conditional ultimate corrosion fatigue was not reached. Wire made of steels 55 and 60 has the highest indices of corrosion-fatigue resistance in tap water, and wire of steels 50G, 50GS and

Card 1/2

A study of the endurance of card wire

S/137/62/000/001/201/237
A154/A101

50Ti have the lowest indices. The emulsions used in fiber-combing are less aggressive media than tap water. A conditional ultimate corrosion fatigue of 55 kg/mm² was established for wire of steels 55 and 50G in emulsion of the Krasnokholmskaya fabrika (Krasnyy Kholm factory), while for wire of steels 60, 50GS and 50Ti this limit was reached at a stress of 35 kg/mm² in these conditions. The emulsion of the Kupavinskaya fabrika (Kupava factory) is less aggressive than the emulsion of the Krasnyy Kholm factory. In the former emulsion a conditional corrosion-fatigue limit of 55 kg/mm² was established even for wire of the worst steel - 50 Ti. Card wire of steel 55 made of polished wire rod has higher endurance indices in tap water than wire of the same steel, but made of unpolished wire rod. Preliminary grinding of the wire rod before the latter is drawn into wire may be considered as one of the methods for prolonging the service life of card clothing.

Authors' summary

[Abstracter's note: Complete translation]

Card 2/2

5/062/61/000/002/002/012
B115/B207

AUTHOR: Tomashov, N. D.

TITLE: Control factor and corrosion protection of metals

PERIODICAL: Izvestiya Akademii nauk SSSR. Otdeleniye khimicheskikh nauk, no. 2, 1961, 236-245

TEXT: The author classified the various methods of corrosion protection not with respect to their application or technology, but on the basis of the theory of electrochemical corrosion and the mechanism of each method. For this purpose, it was necessary to determine the control factor of each individual protection method, i.e., the degree of inhibition of the corrosion process with application of the respective protection method. It is known from publications that the dependence of the corrosion current characterizing the corrosion rate on the factors of electrochemical corrosion is represented by the following ✓

equation: $I = \frac{V_k^0 - V_a^0}{P_k + P_a + R}$, where $V_k^0 - V_a^0$ denotes the difference of

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the initial equilibrium potentials of the cathodic depolarizing process (V_k^0) and the anodic reaction of metal dissolution (V_a^0) or, in other words, the degree of thermodynamic instability of the respective system; the denominator characterizes the general inhibition of the system; P_k the mean cathodic, P_a the mean anodic polarizability, R the total ohmic resistance of the system. Proceeding from this method, the author establishes a scientific classification of various protection methods on the basis of their effect upon: I) Reduction of the degree of instability of the system, II) inhibition of the cathodic process, III) reduction of the anodic process, IV) increase of the ohmic resistance of the system. The most important data of the table are as follows: I, II, III, and IV are compiled as A: change of the promoting or inhibiting factors of the corrosion process.

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B	C
General characteristics of the protective measure	Concrete methods of corrosion protection
I { Change of internal factors (of metal) Change of surface factors of the product	1) Alloying increasing the thermodynamic stability of the alloy; 2) admixtures to the alloy increasing the continuity of the resulting corrosion products 1) Coating with a continuous layer of a nobler metal; 2) insulation- and varnish coatings; 3) lubricants; 4) lining and coating with non-metallic substances; 5) oxide-, phosphate-, and other films; 6) enameling; 7) metal coatings forming corrosion layers of higher protection ✓

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	Change of external factors (of external conditions or of the corrosive medium)	1) Change of the external medium forming a layer with higher pro- tection; 2) change of the corrosion conditions causing a layer of higher protection; 3) change of the corrosion conditions in such a way that the corroding agent is kept apart from the metal surface
	Change of internal factors (of the metal)	1) Reduction of the surface of cathodic spots in the metal; 2) introduction of admixtures to the alloy increasing the overvoltage of cathodic depolarization
II	Change of surface factors of the product	1) Metal coatings with a high overvoltage of cathodic depolariza- tion; 2) non-metallic coatings with the same effect as above, or an inhibiting effect toward the diffusion of cathodic products in the film

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Change of external factors
(of external conditions or
of the corrosive medium)

Change of internal factors
(of the metal)

Change of surface factors
of the product

Change of external factors

- 1) Introduction of cathodic inhibitors into the solution; 2) reduction of concentration of the cathodic depolarizers on the cathode; 3) cathodic electrochemical protection
 - 1) Alloying increasing the anodic passivation capacity of the alloy;
 - 2) introduction of active cathodes into the alloy
- 1) Surface treatment of the metal increasing the passivation capacity (polishing); 2) coating of the product with a layer of stronger passivating metal; 3) varnish coatings or lubricants with a passivating dye
 - 1) Introduction of anodic inhibitors or production of a stronger passivating external medium; 2) anodic

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IV	Change of internal factors (of the metal) or the surface factors	electrochemical protection (inhibition of anodic processes due to the occurrence of passivity) No clear examples
	Change of external factors	Increase of the ohmic resistance, e.g.: drying of the bottom or dehydration of liquid fuels

In general, those protection methods are most efficient which act upon the chief control factor of corrosion. If several protection methods with the same control protection factors are applied at the same time, efficiency increases; if control protection factors are not the same, it may decrease. The protection methods reducing the degree of thermodynamic instability, always entail a corrosion reduction, the effect of these methods is, however, smaller if the total inhibition in the system is very high.

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There are 1 table and 14 references: 8 Soviet-bloc and 6 non-Soviet-bloc.

ASSOCIATION: Institut fizicheskoy khimii Akademii nauk SSSR
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SUBMITTED: August 3, 1959



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AUTHOR: Tomashov, N.D., Doctor of Chemical Sciences, Professor,
Chernova, G.P., Candidate of Chemical Sciences

TITLE: New method of electrochemical protection of metals against
corrosion-anode polarization.

PERIODICAL: Khimicheskoye mashinostroyeniye, no. 3, 1961, 30-33

TEXT: The authors state that there are many electric-protection methods which are applied in industry in order to prevent metals from corroding as described by N.D. Tomashov (Ref. 1: Teoriya korrozii i zashchity metallov [Theory of corrosion and metal protection], Izd. AN SSSR, 1959), (Ref.2: Zashchita metallicheskikh konstruktsiy ot korrozii protektorami [Protection of metal structures from corrosion by means of protectors], Oborongiz, 1940), and by V.A. Pritula (Ref. 3: Katodnaya zashchita zavodskoy apparatury [Cathode protection of industrial equipment], Goskhimizdat, 1954). None of these methods use anode polarization. Nevertheless, anode polarization can be used as corrosion protection, if a metal in a given medium tends to passivation; the passivity of the metal considerably reduces the anodic dissolving. The resistance to corrosion of some metals and alloys (iron, stain-

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less steel, titanium, zirconium, tantalum, etc.) is based on the passivity phenomena. The passivity of these metals can be established by increasing the oxidation effect of the medium, or by anode polarization of the metal. A constant passivity potential of the metal can be maintained by an electronic automatic-regulation device, i.e. a potentiostat. The displacement of the metal-potential in the electrolyte solution necessary for obtaining the passive state can be generated by the following methods: by changing the oxidation-deoxidation potential of the medium as described by J.D.Berwick and U.R. Evans (Ref.4: "Journal of Applied Chemistry", v. 2, no. 10, 1952), by anode polarization from an external electric source as described by C. Edeleanu (Ref. 6: "Nature", v. 173, no. 4407, 1954), through contact with an electrically positive metal having a large enough surface as described by the authors (Ref. 7 Tomashov, N.D., Chernova, G.P., Issledovaniya po nerzhavayushchim stalyam [Stainless-steel investigations], izd. AN SSSR, 1956), by B.W. Buck Sloope and H. Leidheiser (Ref. 8: "Corrosion", v. 15, no. 11, 1959) and by M. Stern and H. Wissenberg (Ref. 9: "Journal of the Electrochem. Soc.", v. 106, no. 9, 1959), by introducing ions of precious metals into the solution, and by introducing a cathode hardener into the alloy. In order to determine the potential range within which the metal has the smallest dissolving speed, potentiostatical curves must be plotted. Fig.2 shows such curves for 2X18H9

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(2Kh18N9) steel. Since inter-crystalline corrosion is one of the disadvantages of stainless steel, the authors together with O.N. Markova (Ref. 16: "Zhurnal prikladnoy khimii", v. 33, no. 6, 1960) investigated the effects of anode polarization on the above-mentioned phenomena using 2Kh18N9 steel which tends considerably to inter-crystalline corrosion after tempering at 650° for 2 hours. The results are compiled in table 2. Table 3 shows the limits of the stable passive-state range of 2Kh18N9 steel hardened at 1050° (15 minutes) and tempered at 650° (2 hours) in H₂SO₄ solutions. Fig.4 shows the anode polarization curves for titanium. The authors state that anode electrochemical protection can be used when the aggressive fluid has a good conductivity. The potential range in which the metal is sufficiently passive is large enough for the reliable operation of an industrial automatic potentiostat, this value must not be smaller than 50 millivolts as described by J.D. Sudbury, O.L. Riggs and D.A. Schock (Ref. 17: "Corrosion", v. 16, no. 2, 1960). At present, the anode protection method is being introduced into industry. It has been proposed for titanium under the effect of HCl and H₂SO₄ as described by A.H. Barber (Ref. 19: "Corrosion, prevention and control", v. 6, no. 11, 1959). Anodic protection of devices during sulfurization is already being used as treated by D.A. Schock, O.L.Riggs,

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and J.D. Sudbury (Ref. 21: "Corrosion", v. 16, no. 2, 1960) and by O.L.Riggs, M. Hutchison, N.L. Conger (Ref. 22: "Corrosion", v. 16, no. 2, 1960). The passivity of the metal can be kept constant not only through anode polarization from an external current source, but also through electric contact of the protected part with the metallic protector of an electric furnace. M. Pražák (Czechoslovakian patents, 86080, 150157) has proposed such a protection method for chrome-nickel steels in hot H₂SO₄ solutions; he recommends metal oxides, i.e. Fe₂O₄ or MnO₂ as protector materials. The experimental results obtained and the above-mentioned literature show that wide-scale industrial application of the anodic method for protecting carbon steel, stainless steel, titanium and other metals (which have a passivation tendency) from corrosion, is possible. There are 5 figures, 4 tables, and 22 references, 14 Soviet-bloc and 8 non-Soviet bloc. The four most recent English-language publications read as follows: J.D. Sudbury, O.L. Riggs, D.A. Schock, "Corrosion", v. 16, no. 2, 1960; A.H. Barber, "Corrosion, prevention and control", v. 6, no. 11, 1959; D.A. Schock, O.L. Riggs, J.D. Sudbury "Corrosion", v. 16, no. 2, 1960; O.L. Riggs, M. Hutchison, N.L. Conger, "Corrosion", v. 16, no. 2, 1960.

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AUTHORS:

Matveyeva, T. V., Tyukina, M. P., Pavlova, V. A.,
Tomashev, N. D.

TITLE:

Research on the anodizing of titanium in sulfuric acid
solutions

PERIODICAL: Referativnyy zhurnal. Khimiya, no. 13, 1962, 410, abstract
13K166 (Sb. "Titan i yego splavy". no. 6. M., AN SSSR,
1961, 211-220)

TEXT: Research into a process of anodizing Ti is described. The composition (in %) tested was Fe 0.13; Ni 0.15; Si 0.17; C 0.05; N₂ 0.098, Cu 0.34; with Ti forming the remainder in solutions of H₂SO₄. The authors studied the growth and properties of the films in relation to the time of anodizing (up to 8 hours); D_a (1-10 a/dm²); temperature (20-100°C) and concentration of H₂SO₄ (0-80%). Anodizing of Ti in H₂SO₄ at about 20°C occurs at a high terminal voltage (up to 100 v) and results

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